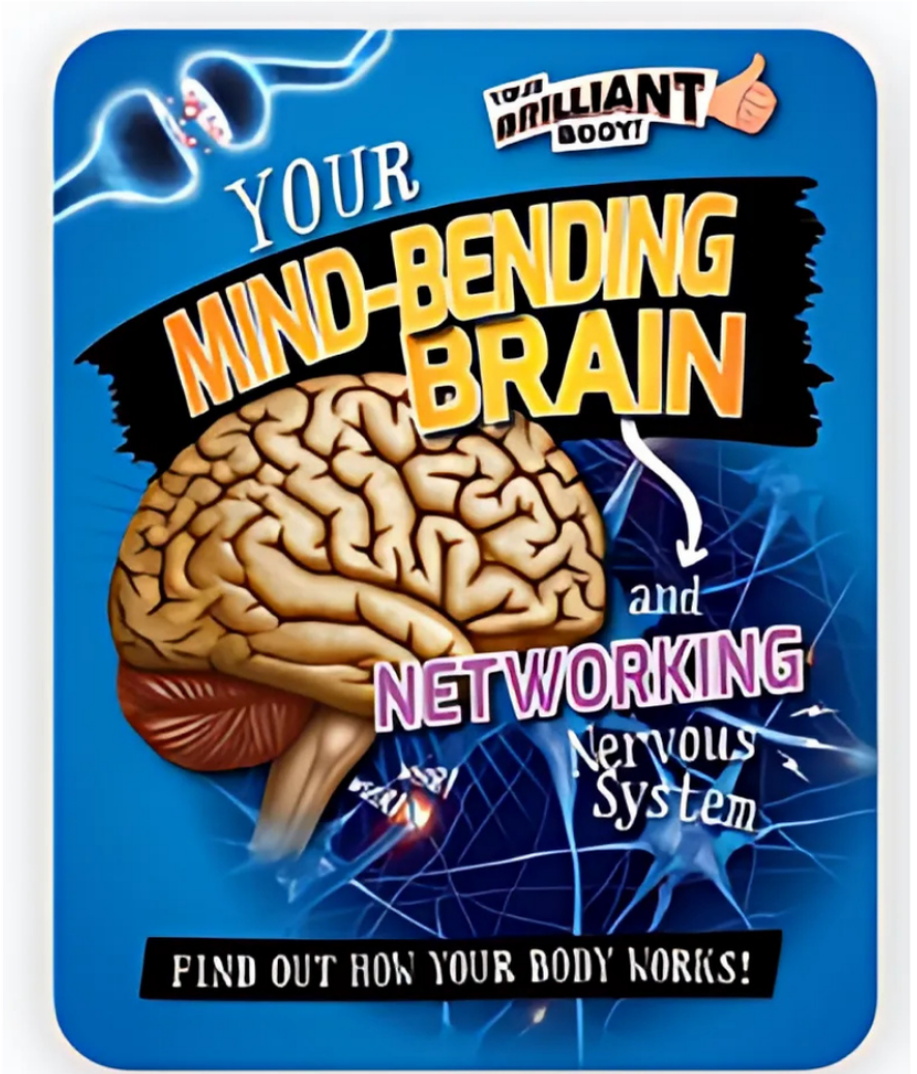

YOUR BRILLIANT BODY!

YOUR MIND-BENDING BRAIN and Networking Nervous System

FIND OUT HOW YOUR BODY WORKS!

Paul Mason

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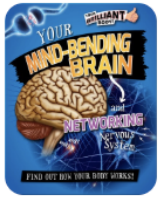

Your Mind-Bending Brain and Networking Nervous System

Your Mind-Bending Brain and Networking Nervous System takes readers on an entertaining tour of the body's brain and nervous system.

THE HUMAN BODY | THE 5 SENSES | SOCIAL EMOTIONAL LEARNING | BIOLOGY

Favorite

Earn These Badges

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By: Paul Mason

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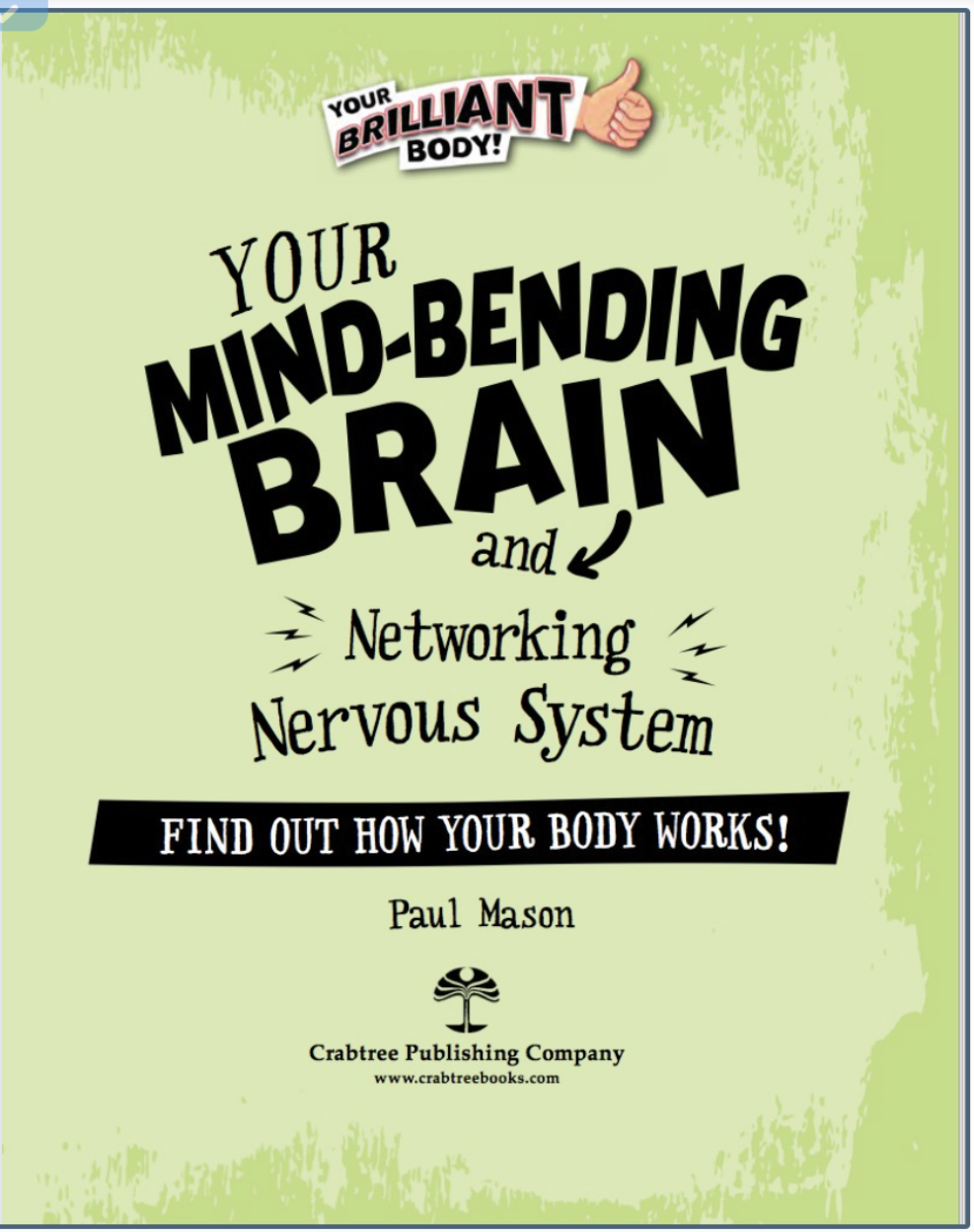

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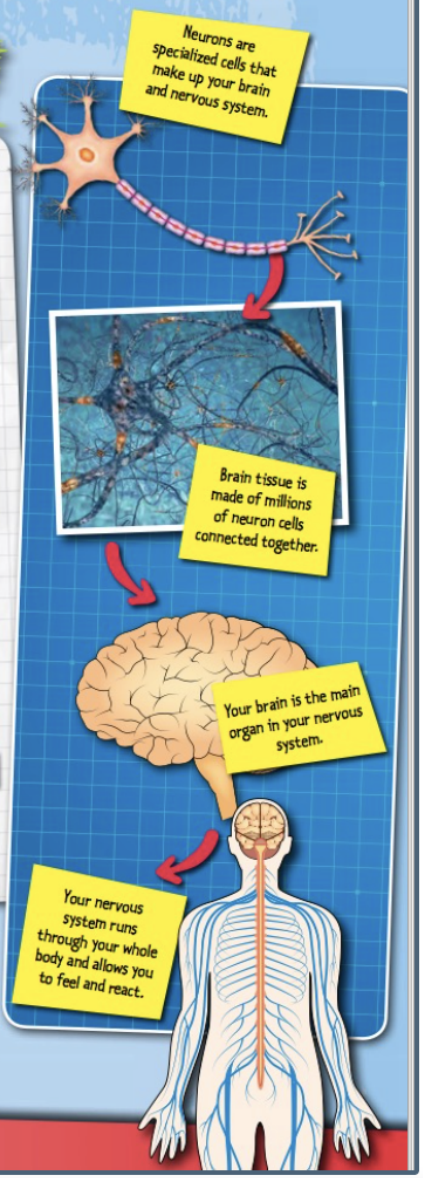


YOUR MIND-BENDING BRAIN

Your brain makes up just about 2% of your body weight—but it's so energy- and oxygen-hungry that while you're awake, it demands 20% of your body's supplies.

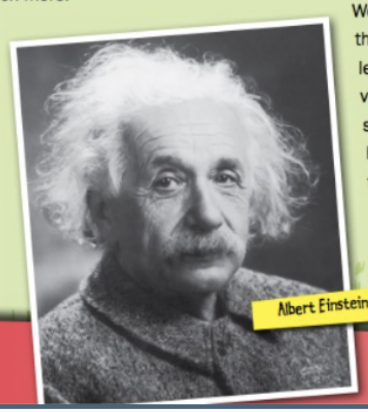
BRILLIANT BODY FACT

Your amazing brain generates enough electricity on its own to power a lightbulb!

So what does your brain actually do?

The simple answer is, your brain is in charge of everything! Using the nervous system, it sends messages to make sure you keep breathing, your heart keeps beating, your stomach processes food, it's possible to walk, talk, touch your nose with your fingertip while your eyes are shut, and much more.

Your brain is also a storehouse for memory. It lets you recognize people's faces and understands their expressions to communicate what mood they are in. It remembers language and stores all kinds of information, such as where you left your phone, or the date of your mother's birthday.



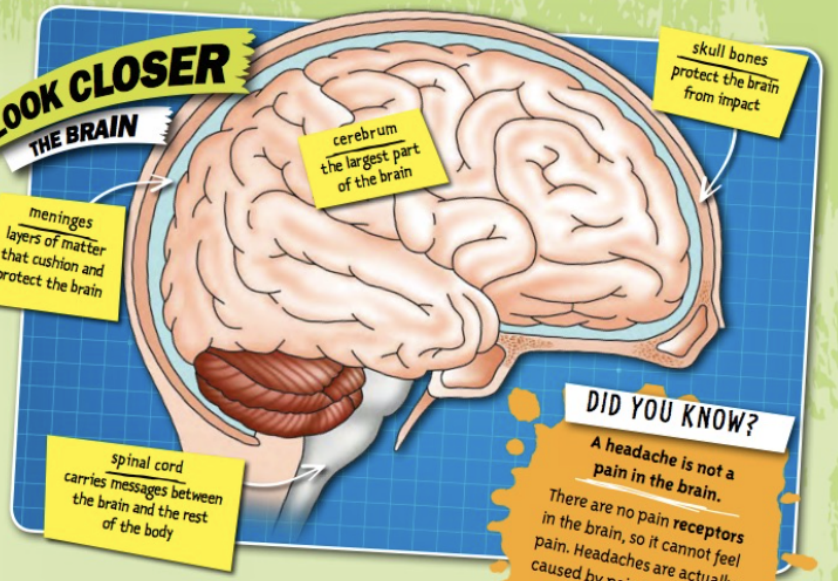
Albert Einstein

Pieces of the brain

The brain is divided into several areas, each of which has its own job to do. One important division is between the right and left sides. Weirdly, the right side of the brain controls the left side of the body, and vice versa. People with special abilities often have special brains, too. For example, the math and physics portions of Albert Einstein's brain were a third larger than the average brain. Taxi drivers in London, England, who have to remember every street in the huge city, often have a bigger-than-average **hippocampus**—the part of the brain associated with memory (see page 17).

LOOK CLOSER

THE BRAIN



DID YOU KNOW?

A headache is not a pain in the brain.

There are no pain **receptors** in the brain, so it cannot feel pain. Headaches are actually caused by pain in tissue that surrounds the brain.

Still working while you sleep

While you are asleep, your brain continues with its background maintenance functions, such as breathing. But it has a lot of spare capacity—some of which it seems to use for dreams. Everyone dreams, but not everyone remembers them. Not everyone dreams in color, either. About 12% of us dream in black and white

DON'T TRY THIS AT HOME!

Brain surgery has a long history—archaeologists have found evidence of crude brain operations being done over 4,000 years ago.

The operation, known as trepanning, seems likely to have been an extreme attempt to cure REALLY bad headaches. It was done by drilling a hole into the skull to try to relieve pressure on the brain. Ouch!

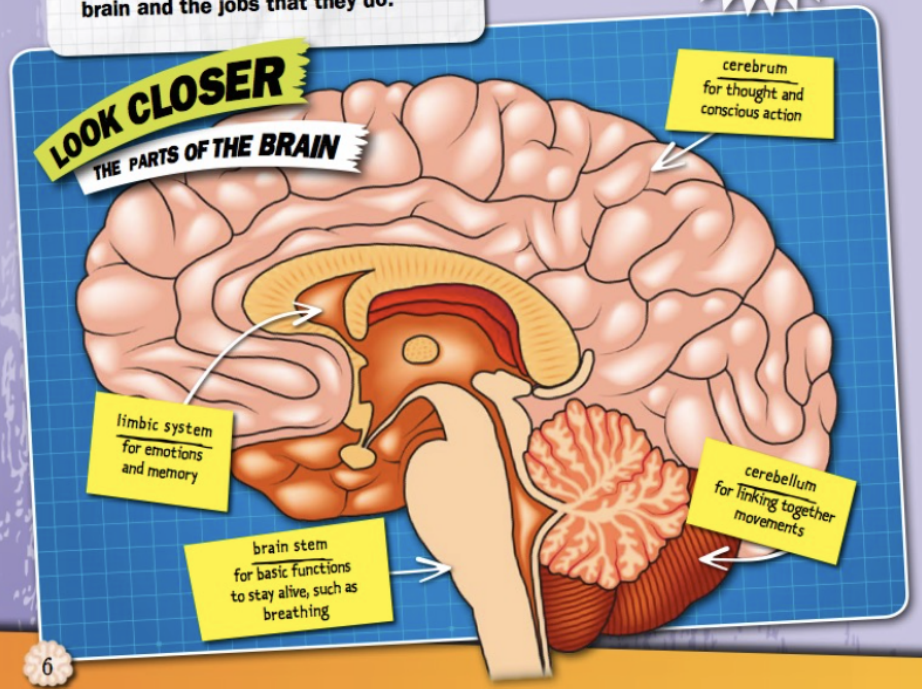
PARTS OF YOUR BRAIN

Your brain is a bit like a sports team. It is made up of individual parts working together to do a job. Here are some important parts of your brain and the jobs that they do:

BRILLIANT BODY FACT

Almost all adult brains are a similar size—and there's no proof that a big brain guarantees intelligence.

LOOK CLOSER
THE PARTS OF THE BRAIN

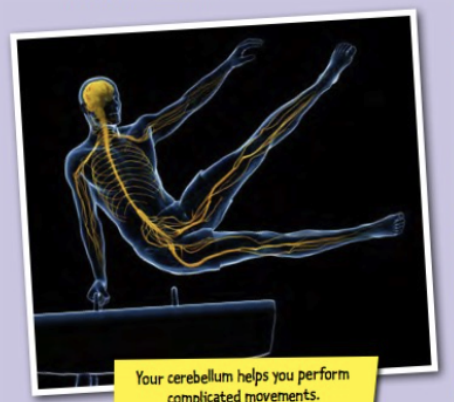


Making plans

Deciding to kick a soccer ball at a goal might SOUND simple—but you couldn't make even easy decisions like this without a **cerebrum**. This is the largest area of the brain, and it's where you do your thinking and planning.

Running and jumping

From walking to skateboarding, surfing or gymnastics...actually, for ANYTHING that involves balance and coordination, you need a **cerebellum**.



Your cerebellum helps you perform complicated movements.

STRANGE BUT TRUE!

Your brain gets most of its energy from **glucose** in your blood. Every part of the brain needs energy, so your brain is estimated to contain about 404 miles (650 km) of blood vessels.

DID YOU KNOW?

The cerebrum is the biggest, heaviest part of your brain.

In adults, it makes up about 85% of the brain's total three lbs (1.36 kg). That's just a bit more than an average-sized pineapple.

Without thinking

Are you breathing? Is your heart beating? Is your stomach digesting your breakfast? And most importantly, did you have to THINK about doing any of these things?

The answers are yes, yes, yes, and no!

The reason is that your **brain stem** controls all these things (and more) without you having to think about them.

So many emotions

If you're feeling happy, excited, or relaxed, you can thank your **limbic system**. It's also to blame if you start crying or throw a hissy fit, though. This tiny area, buried deep inside the brain, affects emotions. It also helps you form memories.

Feeling happy? That's your limbic system.

GROWING A BRAIN

BRILLIANT BODY FACT

A toddler's brain grows over a million new connections EVERY SECOND!

No baby arrives with a fully developed brain—otherwise the head would be too big for it to be born! Once a baby is born, its brain continues to develop.

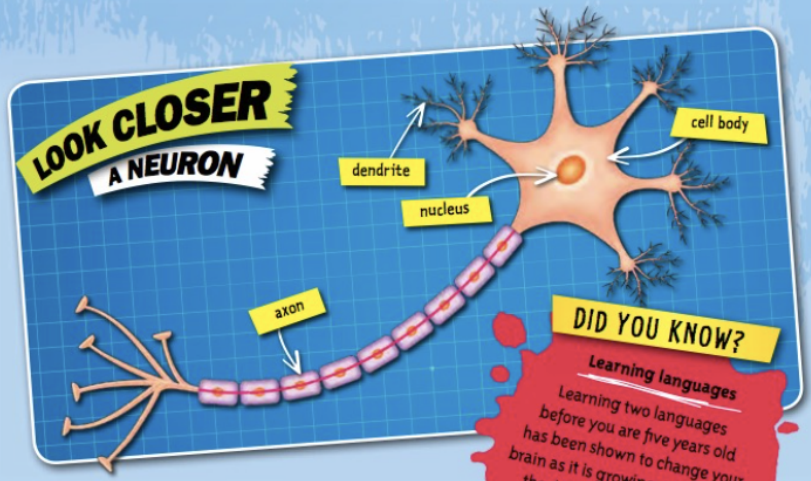
A baby's brain begins to develop while it is still in the womb.

Growing synapses—as easy as riding a bike

The key raw material for a brain is a cell called a **neuron**. As your brain develops, the neurons in various parts of your brain connect, forming links called **synapses**. These synapses are what allow your brain to work.

To understand the importance of synapses, consider how much better you were at cycling the hundredth time you rode a bike than the first time. It's because when you have a new experience, such as riding a bike, your brain develops new synapses. These are like a handbook in your brain—a guide for the next time you want to ride a bike.

Once your brain knows how to do it, you do not need to think about how to cycle.



DID YOU KNOW?

Learning languages

Learning two languages before you are five years old has been shown to change your brain as it is growing. It stimulates the development of neurons, the building blocks of your brain.

The more you ride, the stronger your synapses grow. Soon your brain doesn't need to keep checking the handbook anymore. It just automatically controls your riding.

Each new skill you learn, such as a new language, stimulates the brain and creates more connections. Learning to juggle can change the brain's structure in about a week!

DON'T TRY THIS AT HOME!

Back in the Middle Ages, people hadn't yet discovered a reliable anesthetic. Before a brain operation, patients drank dwale (lettuce juice, gall from a boar, opium, henbane, hemlock, and vinegar) instead. Dwale (say "dwaluh") sometimes made patients unconscious—but often it just killed them.

Too many synapses

By the time you're three years old, you have about a quadrillion synapses. Your brain finds it easy to develop new ones until you're about 10 or 11. Then when you're a teenager it starts to prune these down, getting rid of the connections that it no longer needs and making important ones stronger.

Your brain creates new synapse connections for every new thing you learn.

LEFT SIDE, RIGHT SIDE

When you look at a brain, you'll notice that it's divided into two sides. The sides constantly communicate with each other, but they each have separate jobs.

BRILLIANT BODY FACT

Left-handed people have more brain activity on their right side, and vice versa.

Separate tasks

The LEFT side of your brain controls the right side of your body and the RIGHT side of your brain controls the left side of your body. No one really knows why.

Not only that, but the left side seems to focus mainly on tasks such as language, mathematics, and logical thinking. The right side is more interested in music, recognizing faces, and how you feel about things.

Right-sided, left-sided

One side of your brain tends to be **dominant**. Researchers think that this is caused by your **genes**, which are passed on to you from your parents and determine particular characteristics. They have found that genes affect whether you are right- or left-handed.

However, it isn't always that simple. Some people are mixed-handed—they can change hands depending on the task. They may write with their right hand, but use their left hand for batting and throwing in baseball.

In rare instances, other individuals are **ambidextrous**—able to do tasks equally well with either hand.

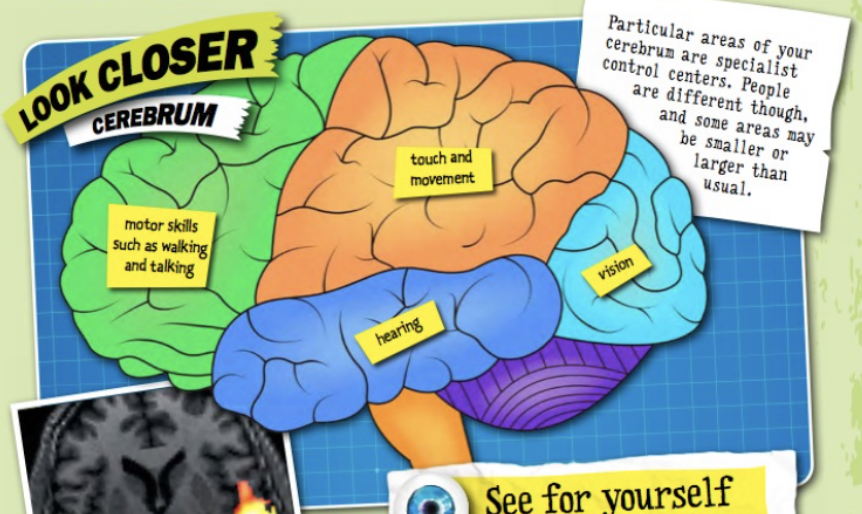
Helping out

Each area of your cerebrum has a specific job to do. However, if one area is damaged, another can sometimes step in to help out. For example, normally your brain needs both sides to process vision—but in Germany, there is a girl who can see despite being born with only one side of her brain.

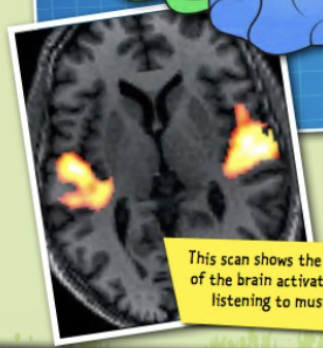
STRANGE BUT TRUE!

About 1% of people are ambidextrous. About 90% are right-handed, and the rest are left-handed. Most people are also left- or right-eyed...but the dominant eye doesn't always match the dominant hand!

LOOK CLOSER



Particular areas of your cerebrum are specialist control centers. People are different though, and some areas may be smaller or larger than usual.



This scan shows the areas of the brain activated by listening to music.

See for yourself

HERE'S A TEST TO SEE WHICH OF YOUR EYES IS DOMINANT.

Cut a circle the size of a small coin in a sheet of paper. Hold the paper away from your face and look at something on the other side of the room. Slowly bring the paper closer to your face until it's in front of one eye. That's the dominant one.

HIGH-SPEED BRAIN WORK

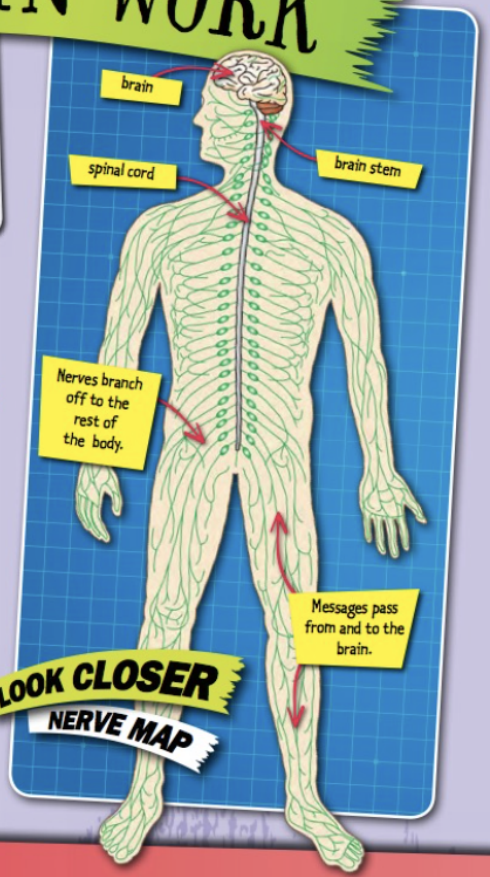
BRILLIANT BODY FACT

Your brain zips messages around at speeds of up to 268 mph (431 kph)!

Imagine what would happen if messages sent to and from your brain ended up in the wrong place. You could mean to kick a ball, but end up poking yourself in the eye!

Delivering instructions

Fortunately, your brain is good at making sure messages are sent where they're needed. It does this through your nervous system, which is like your body's network for instructions. Signals zoom from your brain to the rest of your body (and back again) through the **spinal cord**—a bundle of nerves running down your backbone.



LOOK CLOSER
NERVE MAP

DID YOU KNOW?

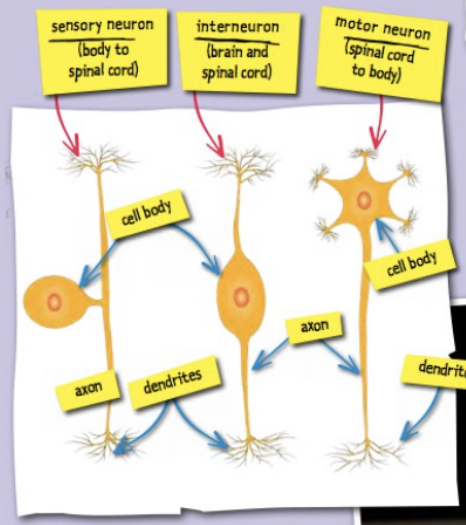
You have about as many neurons in your brain as there are trees in the Amazon rainforest.

When that sentence was written there were about 100 billion trees in the Amazon.

Neural messengers

When a message leaves the brain, it whizzes at high speed down the brain stem and into your nervous system. The "nerves" that send the messages are neurons, like the cells in your brain. You have three main kinds:

- **Sensory neurons** carry messages from the outer parts of your body to the spinal cord.
- **Interneurons** connect within the brain and spinal cord.
- **Motor neurons** carry messages from the spinal cord to the outer parts of your body.



See for yourself

Test the speed of your brain's reactions! Ask a friend to hold a ruler from the highest-numbered end and let it hang down. Put your finger and thumb at zero, but don't touch it. Without warning, your friend lets go and you grab the ruler.

Look at the measurement under your thumb, and use the chart below to calculate your reaction time:

Distance	Reaction time (seconds)
2 in (5 cm)	0.10
4 in (10 cm)	0.14
6 in (15 cm)	0.17
8 in (20 cm)	0.20
10 in (25 cm)	0.23
12 in (30 cm)	0.25

Long and short

Neurons have arms called **axons**. Some of the neurons in your fingertip have axons that stretch all the way to your shoulder, while the ones in your brain are much shorter.

In sports, players need to react quickly. The brain sends a message through the nervous system and the body responds!

YOUR BLINKING BRAIN

BRILLIANT BODY FACT

Humans blink about 20,000 times a day.

Mostly, people don't have to think before they blink. Unless they're fluttering their eyes at someone, that is. Their brain just automatically tells their eyelids to close and open again whenever needed.

Brain on autopilot

It's not only blinking: your brain does a whole LOAD of important jobs without you having to think about them. You wouldn't want to have to remember to tell your body to breathe, for example—what would happen when you went to sleep? Fortunately, your brain automatically handles a lot of everyday work for you.

STRANGE BUT TRUE!

Each time we blink, our brains fill in the gap, so that the world doesn't keep going dark. But it doesn't work if you blink on purpose. This makes the blink bigger, so the gap is harder to fill in.

DID YOU KNOW?

Harvard University has a Brain Bank containing over 7,000 brains.

Scientists use the brains to study the nervous system, and to try to find tests and treatments for diseases that affect the brain.

The amazing brain stem

Although it's a small part of the brain, your brain stem (see page 6) does a lot of the important little jobs that keep you alive (such as making sure your heart beats). Here are just a few of the things your brain stem manages without being told:

DON'T TRY THIS AT HOME!

The Moscow Brain Institute is home to some famous Russian brains. Among them is the leader of the Russian Revolution, Vladimir Lenin.

Lenin's brain was first investigated in 1926 because officials wanted to discover what had made Lenin such a good leader. Scientists have been studying his brain ever since. It has been cut into 31,000 slices! After lots of studying, scientists have decided that Lenin's brain was pretty ordinary.

THE BODY'S HARD DRIVE

BRILLIANT BODY FACT

There is virtually no limit to how much information your brain can store.

Information stored in our brains is called "memory." Your brain is a bit like a computer's hard drive. It stores images, words, smells, and so on.

All your experiences contribute to making new memories.

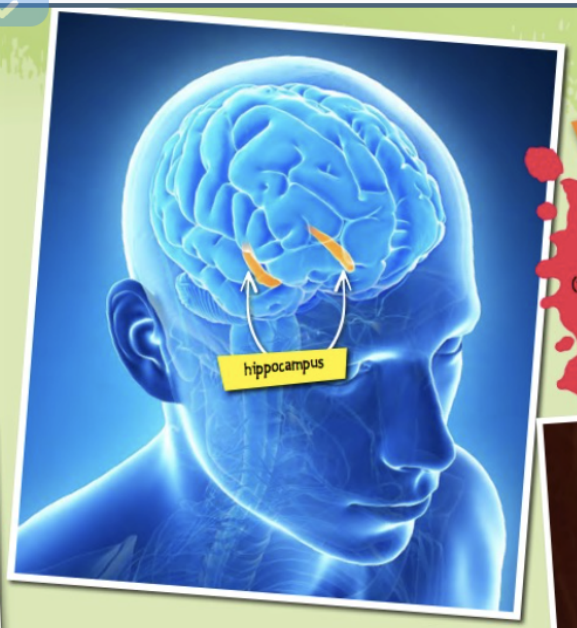
Are all memories the same?

The answer is no. Experts separate memory into three different categories:

1. **Sensory memory**—information from your senses, usually held for less than a second while the brain decides whether to pay attention to it or not.
2. **Short-term memories**—things you need to remember only for a short time. For instance, to understand this sentence, you have to remember that it's about short-term memory.
3. **Long-term memories**—things you hold on to for a long time, such as your phone number, your friend's name, or how to brush your teeth.

What makes a memory?

Memories are made of connections between neurons. Each time your brain does something—smelling freshly cut grass, singing a song—the synapses associated with that action connect more strongly. Memories of places, people, or events are often triggered by smells because the parts of your brain dealing with smell, memory, and emotion are linked.



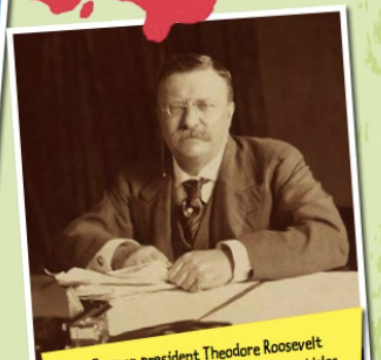
The hippocampus

Forming new memories is associated with a part of the brain called the hippocampus. A normal brain has two hippocampi, one on each side. If one is damaged, the brain can usually shift its memory work completely to the remaining hippocampus. If both are damaged, though, people often have trouble forming new memories, and may even lose old ones.

DID YOU KNOW?

Some people's brains seem to be better at remembering than others.

Roman leader Julius Caesar (100–44BC) had an incredible memory. Once he had met a soldier, however low his ranking, Caesar apparently never forgot his name.



Former president Theodore Roosevelt could memorize entire newspaper articles.

See for yourself

Test your memory with this simple game. Ask a friend to cut out a photo of a person from a magazine. You have 30 seconds to memorize it, then put the photo away.

Have your friend ask you more and more detailed questions about the picture. For each correct answer, you receive a point. Stop when you get two in a row wrong.

SWEET DREAMS

BRILLIANT BODY FACT

Humans can survive for up to eight weeks without eating, but no more than 11 days without sleep.

When you're asleep, your brain continues managing important jobs (such as breathing). But that leaves a lot of spare capacity—some of which it uses for dreaming.

You might not remember your dreams, but you dream every night. We all do!

What is sleep for?

Sleep is a time when your conscious brain turns off, and your body (including your brain) gets a chance to repair itself.

You have two basic sleep modes: **Non Rapid Eye Movement (NREM)** and **Rapid Eye Movement (REM)**. In NREM sleep, which makes up about 80% of your sleep time, your brain is fairly quiet. During REM sleep, though, it becomes as active as when you're awake. This is when you dream.

You can tell if people are in REM sleep because their eyes move around underneath their eyelids. At the same time, their muscles are effectively **paralyzed**, so they barely move.

STRANGE BUT TRUE!

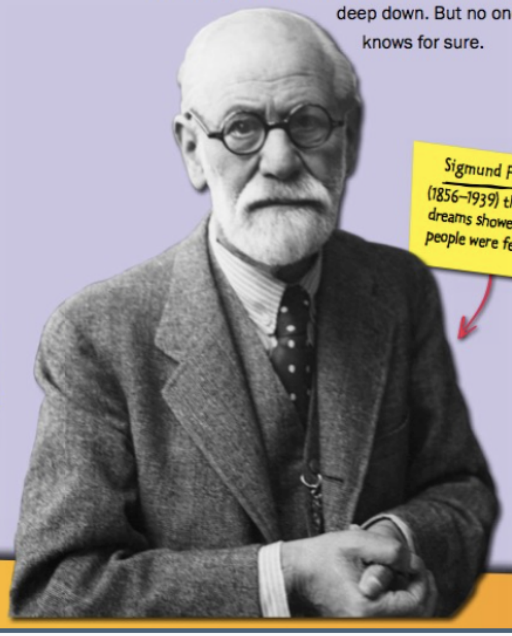
The *Guinness Book of Records* no longer has a category for "Longest without sleep." Going without sleep is too dangerous for it to be encouraged.

Easy to forget

No one remembers every dream. Most people dream for one to two hours each night, and have at least four different dreams. You are most likely to remember dreams if you wake up during them.

What are dreams for?

Surprisingly, experts do not agree on why humans dream—just that everyone DOES dream. Some researchers think dreaming is the brain's way of keeping itself entertained while it doesn't have much else to do. Others think dreams are part of the brain's process of sorting information, deciding what to delete and what to hold on to. Some people believe dreams provide clues to what we are feeling deep down. But no one knows for sure.



Sigmund Freud (1856–1939) thought dreams showed how people were feeling.

DON'T TRY THIS AT HOME!

In 1959, a New York DJ called Peter Tripp went without sleep for 201 hours. After 72 hours, he began laughing, then getting upset, for no reason. Next, he started **hallucinating**. Finally he started claiming he wasn't Peter Tripp at all.

Tripp's family said that his personality changed forever. He became moody, depressed, and hard to live with.

It's harder to sleep high up on a mountain, especially above 13,123 feet (4,000 m). This is thought to be because of the lack of oxygen in the air.

DID YOU KNOW?

Humans spend about 30% of their lives asleep.

That SOUNDS like a lot—until you realize that cats sleep for about 70% of theirs.

YOUR EMOTIONAL BRAIN

Imagine you're out surfing and a fin rises up beside you. When you think "AHHHH! I'M GOING TO BE BITTEN BY A SHARK!" that's your limbic system—sometimes called your "emotional brain"—swinging into action.

BRILLIANT BODY FACT

Showing emotions uses up to 42 different muscles in your face.

Alarm bells ringing

Your limbic system is a) slightly simple minded and b) very fast acting. So even though you know that *logically* the fin is probably a dolphin, or a non-killer shark, your limbic system quickly sends out a "be afraid" message.

Seeing the fin causes neurons to be stimulated and to release "be afraid" chemical signals called **neurotransmitters**. These travel across a synapse and are picked up by another neuron. In no time at all, the message passes from neuron to neuron until it reaches the brain.

When the brain receives the signal, it stimulates more neurons to release more neurotransmitters. These prepare you to either fight the shark (if it IS a shark), or swim away very quickly. This is the fight-or-flight response.

Neurotransmitters travel across the synapse between two neurons.

STRANGE BUT TRUE!

One study has suggested that when people gain power over others, it affects their brains. They become less able to understand what others are feeling.

What causes emotions?

Most experts think that emotions are left over from the early days of humanity. They are preparation for behaving in a particular way. So, for example, when faced with something threatening, our brains generate feelings of either fear or aggression. We're immediately prepared to either fight or run away.

Emotions are not only caused by threats. Happy emotions are the brain's reaction to something good—a nice dinner, scoring a goal, or doing well at school.

DON'T TRY THIS AT HOME!

Phineas Gage was a railway worker who had a VERY bad day back in 1848.

An explosion at work caused an iron bar to go right through Gage's head, destroying most of the front-left part of his brain. Amazingly, within two months after the bar was removed, he was able to walk around, and Gage lived for another 12 years.

Happy emotions may be the brain's reaction to doing something well.

YOUR SUPER SENSES

Your senses swing into action the moment you wake up. From hearing the alarm, to seeing daylight, smelling toast, feeling warm or cold air, tasting orange juice—all these things rely on your senses. But what ARE your senses, and how do they work?

BRILLIANT BODY FACT

You inherit your sense of smell from your parents. If they can smell a smell, you can, too!

What are senses?

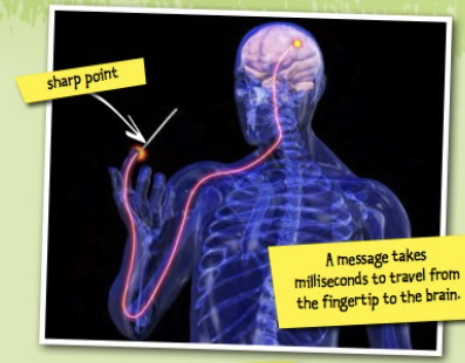
Senses are messages about your environment, sent from your nervous system to your brain. Traditionally humans are said to have five main senses:

- **Sight** relies on your eyes.
- **Hearing** uses your ears.
- **Taste** comes mainly from your tongue.
- **Touch** is made up of messages from your skin.
- **Smell** relies mainly on your nose.

How do senses work?

Your senses rely on receptors—specialized neurons that can detect changes such as brighter light or an increase in temperature. For example, if you prick your finger this is what happens:

1. Receptors in your skin sense that it has been damaged.
2. Neurons in your fingertip whiz electrical signals along your arm to the spinal cord.
3. Neurotransmitters (see page 20) pass the message along the spinal cord to the brain.
4. The **thalamus** decides where the message needs to go: in this case, to the areas of the brain linked with physical sensations, conscious thought, and emotions.



DID YOU KNOW?

People who have lost a limb can sometimes still feel it.

Amputees can sometimes feel an itch, or even pain, in a lost limb—even though it's not there. Experts think this happens when the brain interprets signals from a different part of the body as coming from the missing limb.

Under the skin

One of your most important senses is touch. You receive lots of information whenever you touch something. Below the surface of your skin are lots of specialized receptors. These send your brain messages about your surroundings, such as temperature, pain, pressure, and **texture** (whether something is rough or smooth).

STRANGE BUT TRUE!

Not everyone's senses work in exactly the same way. Some people (about 1% of us) experience sounds as colors, smells as colors, or even colors as smells, or numbers as colors. This mixing of senses is called **synesthesia**.

SIGHT AND SOUND

Each of your eyes is as big as a ping-pong ball—but much, much more complicated. Together with your ears, your eyes provide your brain with information about what's going on around you.

BRILLIANT BODY FACT

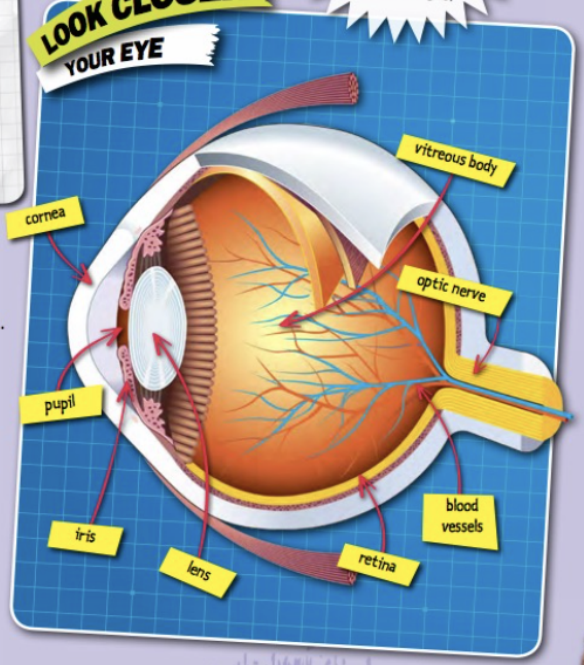
Your eyes can process 36,000 pieces of information an hour. In your lifetime they will record roughly 24 billion images.

From eyeball to brain

An image's journey to the brain begins when light enters your eye. It hits the **retina**, where millions of light-sensitive cells turn the light into nerve signals. The **optic nerve**, which carries over a million nerve fibers, sends these signals to the brain. There, your brain attaches labels to what it's seeing.

LOOK CLOSER

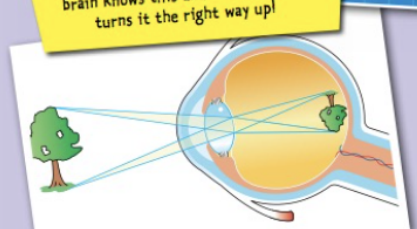
YOUR EYE



The blind spot

The retina sends a complete picture of what you see to the brain. But there is a gap where the optic nerve attaches. This is known as the **blind spot**. Your brain does not register this blind spot, so it fills in the gap automatically.

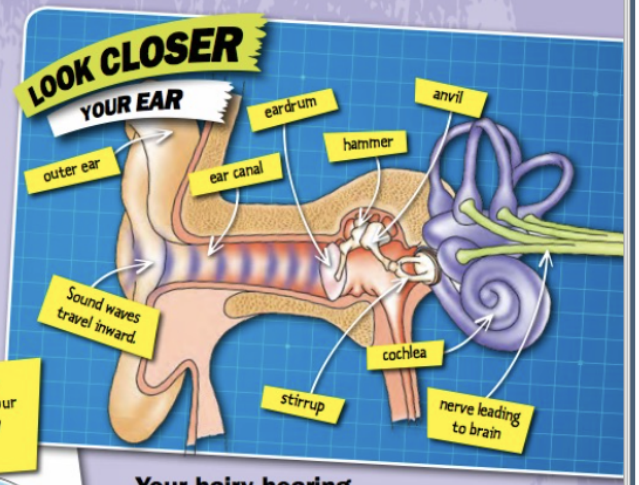
The image your eyes record on your retina is upside down. Fortunately, your brain knows this and automatically turns it the right way up!



Your senses warn you of danger, from the roar of a tiger to the sight of a car when you're crossing the road.

LOOK CLOSER

YOUR EAR



Your hairy hearing

Your hearing depends on little "hair cells" in your inner ear. They're not actually hairs; they get their name from little shapes that stick out from the surface of the cell. When sound vibrations enter the ear, hair cells release neurotransmitters (see page 20). Nerves connecting the ear to the brain pick up the neurotransmitter signals and pass them on to the brain for decoding.

See for yourself

THIS EXPERIMENT TESTS WHETHER TWO EARS ARE BETTER THAN ONE.

Mark an X on the floor, then mark lines 8 feet (2.5 m), 16 feet (5 m), 25 feet (7.5 m), and 33 feet (10 m) away. Blindfold someone standing on the X. Now call his or her name from various lines keeping your voice at the same volume. Ask him or her to guess which line you are standing on.

Repeat the exercise, but with the blindfolded person wearing an earplug in one ear. Is he or she as good at figuring out the distances?

SMELL AND TASTE

BRILLIANT BODY FACT

You are equipped with six MILLION smell-detecting cells! Don't feel too pleased with yourself, though: dogs have about 200 million.

Most humans have a favorite smell. Usually your favorite smell reminds you of something good. It might make you feel happy, hopeful, or full of energy. This is because smells and emotions are closely linked. Smell and taste are also closely linked. In fact, most of what you THINK is taste is actually the smell of your food.

Animals have favorite flavors too! Cats apparently like a plant called valerian, lions like mint, and camels like tobacco!

Food safety alert!

Have you ever spat out a piece of rotten food, which would have given you an upset stomach? If so, you will know that together, smell and taste are an important early-warning system for your body. They help you decide if a food is safe to eat.

See for yourself

AROUND 80% OF WHAT WE THINK IS TASTE IS ACTUALLY SMELL.

You can test this for yourself by holding your nose next time you eat something. Then taste it again normally. Was the taste stronger or weaker the first time?

STRANGE BUT TRUE!

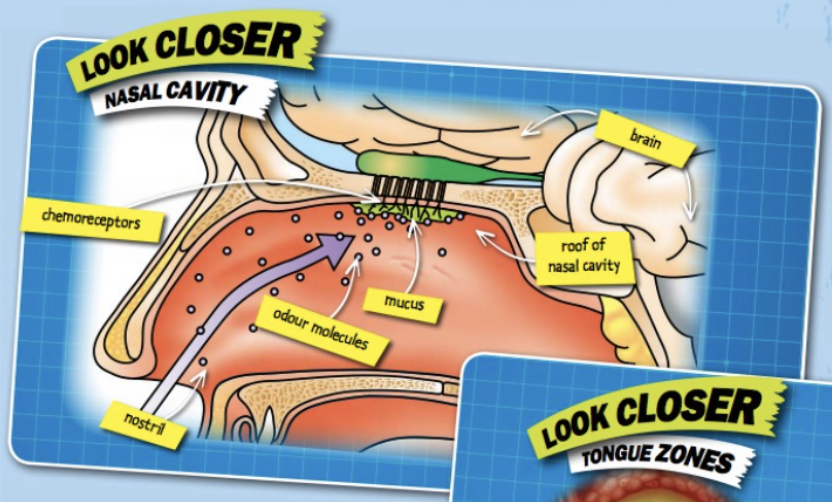
Some people have extra taste buds, plus brains that are super-sensitive to the flavors of food and drink. These people are called supertasters.

Other people have fewer taste buds, and cannot taste as well as normal. And to make matters worse, they don't even get their own special name!

How do we smell?

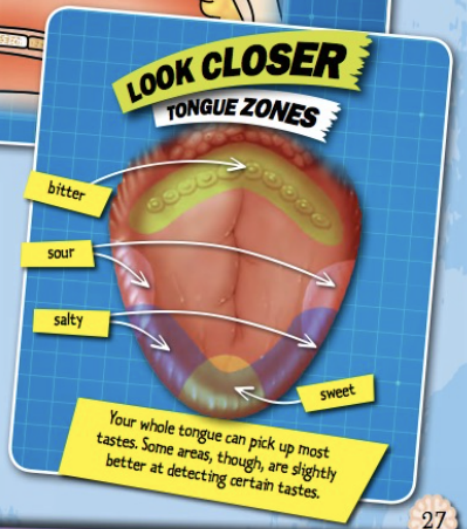
The air is full of tiny particles called odor molecules. These come from all kinds of sources: cut grass, wood, pencils, cooking food, and many more. Your nose is equipped with special cells called **chemoreceptors**.

The chemoreceptors pick up molecules when you breathe in or sniff. Each chemoreceptor is specialized, and can only pick up a particular kind of molecule. The chemoreceptor then sends a message to your brain, signaling what kind of molecule has been detected—in other words, what you are smelling.



What is taste?

Taste works in a similar way to smell. Instead of being in the air, the molecules are contained in your food. They mix with saliva as you chew your food, and are detected by chemoreceptors on your tongue. Chemoreceptors on the tongue are often called taste buds. They send messages to your brain, so that it knows what you are eating.



MAINTENANCE AND SERVICING

You only have one brain, so it's important to keep it working properly. Looking after your brain will mean you do the best you can at any activity that involves your brain—which is basically ALL activities.

BRILLIANT BODY FACT

The brain can live for four to six minutes without oxygen. After that, parts of it begin to die.

1 Keep it working!

Learning new things helps the brain generate new cells. This is especially true if you learn things that involve both physical and mental activity, such as playing an instrument.

2 Eat right!

What you eat affects your brain in lots of ways:

- Oily fish such as mackerel and sardines contain essential fatty acids. Eating plenty of these is said to be good for your memory.
- A daily sprinkle of pumpkin seeds provides zinc, which your brain needs for memory and conscious thought.
- Get fruity! Vitamin C is thought to increase the speed at which your brain can process thoughts. Fruits containing lots of vitamin C include black currants and citrus fruits.
- Eating vegetables containing B vitamins has been shown to help older people keep their brains working well.

3 Work out!

This is a big one: exercising makes more blood flow to the brain, which is crucial for keeping it healthy. The extra blood flow increases the number of tiny blood vessels in your brain and helps the growth of synapses.

4 Avoid cigarettes, alcohol, and illegal drugs!

Each has been linked to decreased brain function. One study in the United States found that even smoking a single cigarette a day stopped your brain from working as well as before. One alcoholic drink a day also affects your brain. Illegal drugs have a serious negative effect on your brain, too.

DID YOU KNOW?

Up to 15% of people walk in their sleep.

It is most common in young children, but some adults sleepwalk too. Sleepwalking seems to run in families, and is also more common among twins.

DID YOU KNOW?

Brain training probably won't work.

You can train your brain to get better at most things: be better at Sudoku, crosswords or computer games, for example. But this won't make your brain better at other activities.

5 Sleep plenty!

Sleep is crucial for the brain—when their brain functions are tested, people usually do significantly worse when they are tired than after plenty of sleep.

6 Wear a helmet!

Banging your head can damage your brain. Always wear a helmet for activities that put you at risk of risk bumping your head.

BRAINY WORDS!

Note: Some boldfaced words are defined where they appear in the book.

amputee A person who has lost an arm or leg in an accident or operation

axon A long branch of a nerve cell. Messages are sent from the cell body along the axon to other cells.

brain stem The part of the brain associated with vital actions such as breathing and digestion

cell body The main part of a cell that contains the nucleus

cerebellum The part of the brain at the back of the skull, it is associated with movement and balance

cerebrum The largest part of the brain, most often associated with conscious thought and actions

conscious Aware of; conscious thoughts and movements are ones you know you are making

dendrite A short branch of a nerve cell that receives messages from other nerve cells via synapses

dominant Having power or control over something

gene A unit of code that passes on characteristics from parents to children

glucose The main type of sugar in blood and a major source of energy for the body's cells

hallucinating Seeing things that are not really there

limbic system Also called the "emotional brain," part of the brain associated with emotions and memory

neuron A specialized cell that is able to transmit information through the brain and nervous system

neurotransmitters Chemical signals used by the brain and nervous system to pass messages between neurons

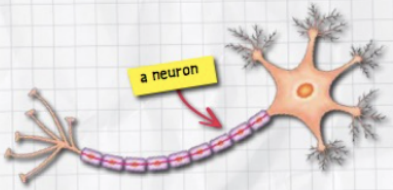
nucleus A cell's control center

paralyzed Unable to move

receptors Specialized neurons that can detect changes such as brighter light or an increase in temperature

retina A light-sensitive inner layer at the back of the eye that converts the images formed by the lens into signals which reach the brain through the optic nerve

thalamus An area deep within the brain, associated with movement, passing sensory messages, and sleep



FOOD FOR YOUR BRAIN

Are you hungry for extra information about your brain? Here are some good places to find out more:

BOOKS TO READ

Burnstein, John. *The Astounding Nervous System: How does my brain work?* Crabtree Publishing, 2009.

Einspruch, Andrew. *Brain Works*. PowerKids Press, 2014.

Gray, Susan H. *The Nervous System*. The Child's World, 2015.

O'Brien, Cynthia. *Amazing Brain Mysteries*. Crabtree Publishing, 2015.

Rooney, Anne. *A Math Journey through the Human Body*. Crabtree Publishing, 2015.

WEBSITES

http://kidshealth.org/kid/htbw/brain.html
This website is a really good place to find out all sorts of information about the human body. It has an excellent section on the brain.

https://faculty.washington.edu/chudler/introb.html#bb
The University of Washington has a great website on neuroscience with all sorts of information for kids. It includes some easily understood information about the brain, nervous system, and senses.

PLACES TO VISIT

In Boston, Massachusetts, the **Hall of Human Life at the Museum of Science** has over 70 interactive exhibits about how the body works. The museum is located at:

Museum of Science
1 Science Park
Boston, MA 02114
www.mos.org

The **Museum of Science and Industry** in Chicago, Illinois, features YOU! The Experience, a permanent exhibition celebrating human life. The museum is located at:

The Museum of Science and Industry
5700 S. Lake Shore Drive
Chicago, IL 60637
www.msichicago.org

In Columbus, Ohio, the **Center of Science and Industry** explores the human body in their exhibition Life: The Story of You. The museum is located at:

Center for Science and Industry
333 W. Broad Street
Columbus, OH 43215
www.cosi.org